DIVISION 5
MATERIAL TESTING

SECTION 05000

MATERIAL TESTING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Employ and pay for services of an independent testing laboratory which is acceptable to Sandy City for the purpose of conducting acceptance and control testing to ensure compliance with contract documents.

B. All testing for control and acceptance will be the responsibility of the contractor.

1.02 RELATED WORK AND REFERENCES

A. Applicable ANSI/ASTM/AASHTO/AWWA practice for inspection and testing agencies.

1.03 DEFINITIONS

A. "Control Testing" is the testing done by the Contractor's testing laboratory to control and establish the Contractor's procedures and materials to assure the work conforms with City specifications.

B. "Acceptance Testing" is the testing required by the City to verify the final product complies with the Contract Documents. Acceptance testing is performed by the contractor's testing laboratory unless the City chooses to perform the testing itself.

1.04 QUALITY ASSURANCE

A. It is the ultimate responsibility of the Contractor to meet or exceed all City Specifications and Standards contained herein.

B. Comply with requirements of ANSI/ASTM E329 and ANSI/ASTM D3740.

C. Correlate control testing with the City's Inspector.

D. "Acceptance testing" will be required by the City as described herein. "Control testing" shall be accomplished as necessary to control the work; however, the City retains the right to direct more control testing, at the contractor's expense, if, in the Engineer's opinion, the work is not being adequately controlled.

E. City retains the right, but is not obligated, to accept material or work based upon the control testing.

F. City testing for acceptance does not relieve contractor of responsibility to furnish materials and construction in full compliance with these specifications and the Contract Documents.

G. Failure to detect any defective work or material does not prevent later rejection when such defect is discovered nor obligate Engineer for final acceptance.

H. Testing agency and its representatives are not authorized to alter any requirement of these specifications or the Contract Documents, nor to approve or accept any portion of the work.

I. Work shall not proceed until quality control personnel are on the job site.

1.05 CONTRACTOR'S SUBMITTALS

A. Prior to start of work, submit testing laboratory name, address, and telephone number and the following:

1. The person charged with the engineering managerial responsibility.
2. The supervising laboratory technician.
3. The supervising field technician.
4. The registered professional engineer on staff.

1.06 TESTING LABORATORY REPORTS

A. Submit field test reports immediately to the Engineer, no later than 24 hours after testing.

B. Submit a formal report to Engineer within 72 hours after sampling or testing, or as determined by Engineer. All reports shall include:

1. Project title, number and date the report was issued.
2. Date, time and exact location of test. Location determined by permanent reference points.
3. Name and address of material supplier.
4. Identification of product being tested and type of test performed.
5. Identify whether test is an original or a retest.
6. Results of testing and interpretation of results.
7. Name of technician who performed the testing.
8. Submit test reports as follows:
   a. The original report to the Contractor.
   b. Copies of the report to the Engineer.

1.07 JOB CONDITIONS

A. On the basis of visual inspection, the Engineer may accept minimal quantities of material furnished from sources of supply which have recently been found satisfactory under normal testing and sampling procedures.

B. Minimal quantities of materials may be accepted based upon receipt of certificate of compliance. This certificate must be in possession of and approved by the Engineer prior to the placement.

1.08 MINIMUM TESTING LABORATORY RESPONSIBILITIES

A. Maintain a registered Engineer on staff to review services.

B. Calibrate testing equipment at least annually with devices of an accuracy traceable to either National Bureau of Standards or acceptable values of natural physical constraints.

C. Provide sufficient personnel at site and cooperate with Engineer and Contractor in performance of services.

D. Perform sampling and testing of products in conformance with all applicable sections of the Contract Documents and standard specifications.

E. Secure samples using test sampling procedures specified in the applicable codes.

F. Immediately report to Engineer and Contractor the compliance/ noncompliance of materials and mixes with requirements of Contract Documents.

G. When an out-of-tolerance condition exists, perform additional inspection and testing at no additional cost to the City until the specified tolerance is attained. Identify retesting on test reports.

H. If the independent laboratory selected by the Contractor/Developer does not provide necessary information or results as required, the City will have the ability to require the employment of a different testing laboratory at the Contractor's/Developer's expense.

1.09 LIMITS ON TESTING LABORATORY AUTHORITY

A. Laboratory may not release, revoke, alter, or enlarge on requirements of contract documents.

B. Laboratory may not approve, accept or reject any portion of the work.

C. Laboratory has no authority to stop work.

PART 2 PRODUCTS

2.01 MATERIALS

A. Provide all necessary materials and equipment to accomplish control and acceptance testing.

PART 3 CONCRETE TESTING

3.01 CONCRETE TESTING REQUIREMENTS(INCLUDING FLOWABLE FILL)

A. Review and/or test materials in conformance with specifications. Concrete material shall conform to Section 03000, part 2. Flowable Fill shall conform to Section 02230, 2.05.

B. Conduct strength tests of concrete used in conformance with the following procedures:

1. Secure composite samples in conformance with ASTM C 172. Obtain samples from different batches of concrete on a random basis. When testing concrete from a concrete pump, take the sample from the hose after all the priming grout has been wasted.

2. Take four specimens per sample in conformance with ASTM C31. Report deviations from requirements.

3. Test specimens per sample in conformance with ASTM C39. Make at least one strength test for each 50 CY, or fraction thereof, of each mix design of concrete placed in any one day. When total quantity of concrete with a given mix design is less than 50 CY, strength tests may be waived by Engineer if, in his judgement, adequate evidence of satisfactory strength is provided.

C. Perform slump tests with each strength test in conformance with ASTM C143. Reject concrete failing slump test.

D. Determine normal weight concrete air content with each strength test in conformance with ASTM C231.

1. If an air test fails, immediately terminate concrete discharge and retest the same load.

2. The concrete will be rejected if the second air test does not meet the specification.

3. If the second air test meets the specification, a third test will be performed to establish concrete acceptance or rejection.

E. Determine air content and unit weight of lightweight concrete test with each strength test in conformance with ASTM C173 and C567.

F. Determine temperature of concrete for each strength test.

G. Identify on testing reports, location of placement of tested concrete.

3.02 EVALUATION OF TEST RESULTS

A. Concrete strength: As long as averages of all sets of three consecutive strength test results equal or exceed specified strength (f'c) and no individual strength test result falls below specified strength (f'c) by more than 500 psi, concrete strength is considered satisfactory.

3.03 ACCEPTANCE

A. The strength will be determined by the average of the test lot cylinders taken on a specific pour. The test lot will consist of four (4) cylinders, one broken at 7 days and three broken at 28 days. The last three will be used for determining the average strength.

B. Concrete with compressive strength below the required specified strength shall be evaluated by the Engineer for capabilities necessary to the integrity of the structure. The Engineer may accept this concrete, or require that it be replaced with acceptable material. The Engineer shall make the final decision.

3.04 DUTIES OF CONTRACTOR

A. Provide necessary testing services to ensure conformance with proposed materials and establishment of mix designs.

B. To facilitate testing and inspection contractor shall:

1. Furnish labor to assist testing agency in obtaining and handling samples at site or sources of materials.

2. Advise testing agency sufficiently in advance of operations to allow for completion of quality tests and for assignment of personnel.

C. Provide and maintain adequate facilities for safe storage and proper curing of concrete test specimens on site for first 24 hours as required by ASTM C31.

D. Be responsible for remedial work required as a result of failed tests.

PART 4 SOIL COMPACTION CONTROL AND TESTING

4.01 TEST

A. Sieve Analysis Test: AASHTO T-27 (ANSI/ASTM C 136)

B. Laboratory Density Test:

1. For all A-1 soils: AASHTO T-180 (ASTM D 1557) Method D test.

2. For all other soils: AASHTO T-99 (ASTM D 698) Method D.

C. Field Density Test:

1. Determine field density of in-place material by the nuclear test method described in AASHTO T-238 (ASTM D 2922) Method C for shallow depth or AASHTO T-239 (ASTM D 1556).

4.02 SUBMITTALS

A. In addition to the requirements of 1.06B of this section, submit the following:

1. Optimum laboratory moisture content of material tested.
2. Field moisture content of material tested.
3. Maximum laboratory dry density of material tested.
4. Field density of material tested.
5. Percent compaction results.
6. Testing agency certification of test results.

B. Submit records of any retesting.

4.03 GUARANTEE

A. In addition to the Guarantee Provisions, as outlined in the General Conditions, the following applies:

1. Settlement of the fill material within the contract guarantee period is incontrovertible evidence of inadequate compaction of backfill.
2. Correct the deficient conditions, including the replacement and/or repair of the surfacing materials and damaged facilities.
3. The method of construction repair shall be proposed in writing by the contractor for approval by the Engineer prior to correcting the failed condition.

4.04 COMPACTION AND TESTING

A. Moisten or de-water backfill material to obtain optimum moisture content ±2%.

B. Perform the required testing of materials in conformance with specifications as described in this section.

4.05 TEST SCHEDULE

A. Gradation Analysis: As required if in the opinion of the Engineer the material varies from that as approved.

B. Proctor Analysis: As required if in the opinion of the Engineer the material varies from that as approved.

C. Density Testing: A minimum of two (2) tests is required.

1. Curb and gutter with grade: One (1) random test per lift per 400 lineal feet.
2. Sidewalk: One (1) random test per lift per 400 lineal feet.
3. Trenches: One (1) random test per lift per 200 lineal feet.
4. Roadways: One (1) random test per lift per 1000 square yards.
5. Landscaped strips: No testing required.
6. Structural Backfill: Comply with section 02240, 5.03.
7. Additional testing may be required by Engineer.

4.06 DUTIES OF CONTRACTOR

A. Furnish labor to assist testing agency in obtaining and handling samples at site or sources of materials.

B. Advise testing agency and Engineer 48 hours in advance of backfilling operations to allow for testing of pre-placement conditions, completion of quality tests, and for assignment of personnel.

C. Contractor shall bear all costs associated with all remedial or additional work required to bring the material into minimum conformance with the specified degree of compaction and moisture content required as a result of failed density testing.

4.07 ADDITIONAL TESTING

A. Additional testing shall be required:

1. If there are changes in source of materials or proportions requested by contractor.

2. If field density tests indicate that less than the specified minimum degree of compaction is being accomplished.

3. For other testing services needed or required by contractor.

PART 5 BITUMINOUS PAVING COURSE

5.01 SAMPLING AND TESTING

A. Gradation and Bitumen Content:

1. Acceptance of bituminous surface course with respect to gradation and bitumen content is based on the average deviation of the samples taken from the specifications determined by UDOT Test Procedures 8-946 and 8-947. A minimum of one sample per road or per 500 tons, whichever results in a greater number of samples.

B. Sieve Analysis:

1. If the mean of the deviation of the material from the specifications, for a particular sieve or sieves or for bitumen content, is more than the maximum shown under the 1.00 pay factor in Table 05000 - 1, the contractor has the option to remove and replace the road or, upon his written request and the Engineer's approval, accept the lot at an adjusted unit price. In the case of new development, the developer must perform corrective action as indicated in 5.03, C, below.

2. The mean of the deviation shall be defined as and calculated by subtracting the submitted target value from each screen percent (or the screen percent from the target value), then adding these results together. This total shall be divided by the total number of tests. The mean deviation is compared to the deviation from 1,2,3,4 or 5 tests. From this deviation the pay factor is determined.

C. Laboratory shall also conduct a 50 blow Marshall Test of sample for comparison with density test of the core samples required as per paragraph 5.02 B of this Section. Comply with APWA Standards for Superpave.

5.02 ACCEPTANCE

A. Acceptance test locations will be determined by the Engineer using a random selection process. The Engineer will provide ASTM D3665 - 02 "Standard Practice for Random Sampling of Construction Materials" to the Contractor from which random test locations will be selected. Engineer and/or independent testing laboratory will then perform tests based on locations determined by Table 1, ASTM D3665 - 02.

B. Acceptance of the completed course with respect to thickness and density will be on the

basis of cores taken randomly (as specified in 5.02, A), with one core taken per road or every 1000 square yards, which ever results in the greater number of tests.

1. The material tested will be accepted with respect to thickness when the average of the cores taken are not 1/4 inch less than the specified thickness and when no one core shows a deficient thickness of more than ½ inch. In the event a thickness is more deficient than ½ inch the Engineer may require placement of additional material or removal and replacement of paving course.

2. For non-Superpave bituminous courses the placed surface course will be accepted with respect to density when the mean of all density determinations made is not less than 96 percent of maximum laboratory density, as determined by a 50 blow Marshall laboratory test of the sample taken on the project as per paragraph 5.01 C (Marshall tests shall be averaged from the last 10 samples taken on the project), and when no single determination is lower than 92 percent of maximum laboratory density. If test results fall below specified maximum laboratory density, the material represented by that test will be considered defective.

3. For Superpave comply with APWA standard testing requirements.

C. For City projects, if the placed material proves defective, the roadway may be accepted at a reduced price in accordance with 5.03, B of this section. For new development, if the placed material proves defective, the roadway may be accepted after actions are taken to improve defects and/or deficiencies, as per 5.03, B of this section, or as approved by the Engineer.

D. For City projects, areas not acceptable because of deficient thickness shall be brought into compliance by placing additional surface course as approved by Engineer, accepted subject to a price adjustment as per 5.03, A, or removed and replaced. In new development, noncompliance based on deficient thickness shall be brought into compliance by placing an additional surface course as approved by Engineer, accepted as per 5.03, A, or removed and replaced. Patching or overlays less than 1 inch compacted thickness will not be accepted unless otherwise approved by the Engineer.

E. The Engineer will not accept the roadway if the asphalt thickness above any adjacent concrete is more than 0.5 inches, except for overlays.

5.03 PRICE ADJUSTMENT

A. Areas that have deficient thickness of asphalt concrete may be subject to a price adjustment or action only upon contractor's written request and Engineer's written approval. The price adjustments or actions will be as follows; however, the Engineer is under no obligation to accept placement of any deficiently thick asphaltic concrete.

CAPITAL IMPROVEMENTS		DEVELOPMENT	
Average Thickness Deficiency In Core (Inches)	Percent of Asphalt Unit Bid Price to be Paid	Average Thickness Deficiency In Core(Inches)	Required Action
0.00 TO 0.25	100	0.00 TO 0.25	Engineer determined
0.26 TO 0.50	90	0.26 TO 0.75	1" overlay
0.51 TO 0.75	80	0.76 TO 1.25	1.5" overlay
0.76 TO 1.00	50	More than 1.25	Remove and replace
More than 1.00	Remove and replace		

B. For non-Superpave bituminous paving course: Areas that have deficient density of the bituminous pavement in which any production paving day does not equal or exceed an average of 96 percent of maximum laboratory density may be subject to a price adjustment upon written request and written approval. Deficient density in new development will require actions to remedy the deficient density.

The price adjustment or required action will be as follows. However, the Engineer is under no obligation to accept placement of any deficiently dense asphaltic concrete:

		CAPITAL IMPROVEMENT	DEVELOPMENT
Mean Density all Tests	Lowest Density of all Tests	Percent of Asphalt Unit Bid Price to be Paid	Required Action
96 - 100	ABOVE 92	100	None
96 - 100	BELOW 92	95	Type III slurry at problem area
< 96	ABOVE 92	80	Type III slurry over project
< 96	BELOW 92	Remove and replace	Remove and replace

For Superpave use APWA Section 02335, Table 1.

C. If the gradation or bitumen content of any bituminous mixture varies more than the allowable (as determined from gradation and extraction tests), the Engineer may elect to reduce the amount paid for the work in accordance to the procedures outlined in Table 05000 - 1 on page 05000 - 10. For new development, required actions will also be based on the pay scale factor obtained from Table 05000-1 and is subject to the following:

DEVELOPMENT

PAY SCALE FACTOR (TABLE 05000)	REQUIRED ACTION
1.00	None
0.95 to 0.99	2 year extended warranty
0.90 to 0.94	Type III slurry
0.85 to 0.89	1.5" overlay
< 0.85	Remove and replace

D. The Engineer may require state-of-the-art nondestructive testing to resolve disagreements arising from the use of traditional testing and to determine necessary corrective action. The cost of said testing will be at contractor's expense if results confirm noncompliance to the above standards.

TABLE 05000 - 1
PAY FACTORS FOR NONCOMPLYING BITUMEN CONTENT AND AGGREGATE GRADATION

Criteria	Pay Factor	ALLOWABLE VARIANCE Based on number of tests in test lot				
		1 Test	2 Tests	3 Tests	4 Tests	5 Tests or more
Bitumen Content	1.000	0.0-0.7	0.0-.54	0.0-.46	0.0-.41	0.0-.38
	0.975	0.8	.55-.61	.47-.52	.42-.46	.39-.43
	0.950	0.9	.62-.68	.53-.58	.47-.52	.44-.47
	0.900	1.0	.69-.75	.59-.64	.52-.56	.48-.52
	0.850	1.1	.76-.82	.65-.69	.57-.61	.53-.56
½" and larger Sieve	1.000	0.0-10.0	0.0-7.3	0.0-6.3	0.0-5.6	0.0-5.2
	0.975	11.0-12.0	7.4-8.3	6.4-7.1	5.7-6.3	5.3-5.8
	0.950	13.0	8.4-9.3	7.2-7.9	6.4-7.0	5.9-6.4
	0.900	14.0	9.4-10.3	8.0-8.7	7.1-7.7	6.5-7.1
	0.850	15.0	10.4-11.3	8.8-9.5	7.8-8.4	7.2-7.7
3/8" Sieve	1.000	0.0-9.0	0.0-6.9	0.0-5.9	0.0-5.3	0.0-4.9
	0.975	10.0	7.0-7.8	6.0-6.6	5.4-5.9	5.0-5.5
	0.950	11.0	7.9-8.7	6.7-7.3	6.0-6.6	5.6-6.1
	0.900	12.0-13.0	8.8-9.6	7.4-8.0	6.7-7.2	6.2-6.6
	0.850	14.0	9.7-10.5	8.1-8.9	7.3-7.9	6.7-7.2
No. 4 Sieve	1.000	0.0-9.0	0.0-6.7	0.0-5.7	0.0-5.2	0.0-4.8
	0.975	10.0	6.8-7.6	5.8-6.3	5.3-5.8	4.9-5.4
	0.950	11.0	7.7-8.5	6.4-6.9	5.9-6.4	5.5-5.9
	0.900	12.0-13.0	8.6-9.4	7.0-7.5	6.5-7.0	6.0-6.5
	0.850	14.0	9.5-10.2	7.6-8.0	7.1-7.6	6.6-7.0
No. 8 Sieve	1.000	0.0-7.0	0.0-5.6	0.0-4.8	0.0-4.3	0.0-4.0
	0.975	8.0	5.7-6.3	4.9-5.4	4.4-4.8	4.1-4.5
	0.950	9.0	6.4-7.0	5.5-6.0	4.9-5.3	4.6-4.9
	0.900	10.0	7.1-7.7	6.1-6.6	5.4-5.8	5.0-5.4
	0.850	11.0-12.0	7.8-8.5	6.7-7.2	5.9-6.4	5.5-5.8
No. 16 Sieve	1.000	0.0-7.0	0.0-5.2	0.0-4.6	0.0-4.2	0.0-3.9
	0.975	8.0	5.3-5.8	4.7-5.1	4.3-4.6	4.0-4.3
	0.950	9.0	5.9-6.4	5.2-5.6	4.7-5.1	4.4-4.7
	0.900	10.0	6.5-7.0	5.7-6.1	5.2-5.5	4.8-5.1
	0.850	11.0	7.1-7.6	6.2-6.6	5.6-5.9	5.2-5.4
No. 50 Sieve	1.000	0.0-6.0	0.0-4.3	0.0-3.8	0.0-3.4	0.0-3.2
	0.975	7.0	4.4-4.8	3.9-4.1	3.5-3.8	3.3-3.5
	0.950	8.0	4.9-5.3	4.2-4.5	3.9-4.1	3.6-3.8
	0.900	9.0	5.4-5.8	4.6-4.9	4.2-4.4	3.9-4.1
	0.850	10.0	5.9-6.4	5.0-5.5	4.5-4.9	4.2-4.5
No. 200 Sieve	1.000	0.0-3.0	0.0-2.4	0.0-2.0	0.0-1.8	0.0-1.7
	0.975	3.1-3.5	2.5-2.7	2.1-2.2	1.9-2.0	1.8-1.9
	0.950	3.6-4.0	2.8-3.0	2.3-2.4	2.1-2.2	2.0-2.1
	0.900	4.1-4.5	3.1-3.3	2.5-2.7	2.3-2.4	2.2-2.3
	0.850	4.6-5.0	3.4-3.6	2.8-3.0	2.5-2.6	2.4-2.5

END OF SECTION